

was the large amount of injury to needle-leaf evergreens and the small amount of injury to broad-leaf trees and shrubs.

UNIVERSITY OF WASHINGTON,  
SEATTLE

## THE GENUS *EUGENIA* IN THE HAWAIIAN ISLANDS

BY VAUGHAN MACCAUGHEY

One of the large and representative myrtaceous genera that is represented in the Hawaiian flora by both indigenous and exotic species is the interesting genus *Eugenia*. Several arborescent species are abundant in the rain forests and upper valley floors of all the islands; a number of horticulturally important forms are common in Hawaii's many tropical gardens and estates. Inasmuch as there is nowhere in the literature a comprehensive statement of the Hawaiian *Eugenias*, it is the purpose of this paper to bring together the salient data concerning this group of valuable plants.

The genus *Eugenia* was named by Linnaeus in honor of Prince Eugene of Savoy. It comprises some 760 species, and is the largest genus of the family Myrtaceae. Like several other large genera of this family, it has two main centers of evolution, namely tropical Asia and tropical South America. There are a few species in Africa, and also in Australia; the latter region is also an evolution-center for important myrtaceous genera. Most of the *Eugenias* are trees or shrubs, and many are valued for their fruit, wood, or ornamental foliage.

The leaves are opposite, usually entire, and finely penninerved. They are often glandular-punctate and fragrant. The flowers are in trichotomous terminal and lateral or axillary cymes or corymbs; in some instances they are single or few (on short spurs or buds), in the axils of the leaves. The flowers are white or creamy; the conspicuous part of the flower, however, is the long, numerous stamens, which are white or scarlet. The arrangement is tetramerous; calyx-tube globose to elongate, 4- or rarely 5-lobed, or produced above the ovary with 4 (rarely 5),

distinct, imbricate lobes. There are four petals (rarely 5), distinct, or cohering in a cap and falling off together. The stamens have capillary filaments and small, versatile anthers. The ovary is 2- rarely 3-loculed, with several ovules in each locule; style filiform; stigma small. The fruit is a drupe-like berry, usually baccate, globular or pyriform, and crowned by the teeth or truncate remains of the calyx. There are one to five seeds, usually one or two; the embryo is straight, with a short radicle; the cotyledons are thick and usually consolidated into a single mass.

The *Eugenia* of first importance in the Hawaiian flora is the *Ohia ai* or "Mountain Apple," *Eugenia malaccensis* L. (the *Jambosa malaccensis* of P.DC. and other authors). This beautiful tree was introduced by the primitive Hawaiians, and is now abundant in the humid valleys and ravines on all the islands. It is distinctively a tree of the lower forest zone, where it forms pure stands, some of which, in the broad valley floors, cover areas of several hundred acres. It occurs throughout the Pacific, and is abundant in many of the South Sea islands. It is thirty to sixty feet in height, usually about thirty-five feet. The trunk is straight and smooth-barked; the crown is particularly handsome because of the dark green, glossy, abundant foliage.

The leaves are elliptico- or obovate-oblong, 6-7 ins. long by  $2\frac{1}{2}$ -3 ins. broad, on fleshy petioles  $\frac{1}{2}$  inch long; abruptly acuminate, rich dark green, glossy; the sinuate marginal vein is distant from the edge. The flowers are showy clusters of long, spreading, bright red stamens, that contrast charmingly with the rich foliage. During the flowering season, in early summer, the shady interior of the tree seems to be filled with a delicate scarlet haze. The flowers are in axillary cymes, usually cauline, about 2 inches long, the lowest branches three-flowered, the middle or terminal branch racemose. The pedicels are short, gradually enlarging into the calyx. The latter is turbinate, produced beyond the ovary, with four rounded lobes. The petals are minute, obovate, and red; the showy red stamens are three-quarters of an inch long.

The fruits, which constitute the part of greatest interest, are

obovate, about the size and shape of a small pear, 3 inches in diameter, umbilicate at the top and crowned by the truncate scars of the calyx lobes. The very thin, smooth skin is rich crimson, pale pink, or rarely white; the highly colored fruits have a very attractive appearance. The flesh is firm and apple-like, sometimes a trifle fibrous, but filled with a cool, sugary, sub-acid juice, that has a crisp, pleasant flavor. The fruiting season varies greatly, dependent upon the elevation of the tree, but the main season is mid-summer, and at this time the fruits are common in the Honolulu markets.

A rare variety of this tree has white flowers and fruits; this is known to the Hawaiians as *Ohia ai hua keo-keo*. The wood of the *Ohia ai*, like that of the *Ohia ha*, was formerly used by the natives for house and temple timbers, but is not put to commercial use now, save occasionally as firewood. Like other members of the *Eugenia* group, the bark is astringent, and was sometimes used by the natives for medicine.

There are only two indigenous *Eugenia*s in the Hawaiian Islands, *E. sandwicensis* Gray, and *E. rariflora* Benth. The *Ohia ai*, although thoroughly naturalized, cannot be considered indigenous. *Eugenia sandwicensis* (classed as *Syzygium sandwicensis* by Niedenzu in Engler and Prantl) is known to the natives as *Ohia ha*; on the island of Maui it is called *Pa-ihii*. It is a tall tree of 40 to 60 feet, with a trunk of 12 to 18 inches in diameter. The smooth brown bark is readily distinguished from that of the *Ohia lehua* (*Metrosideros polymorpha*). The wood is reddish, hard, fine-grained, and durable; it was formerly used in the construction of native houses and temples. The branches are angular and sharply margined. The leaves are obovate or obovate-oblong, on petioles of  $\frac{1}{2}$  inch; obtuse, subcoriaceous, dark green or sometimes yellowish with red venation. Hillebrand records a variety *parvifolia*, with leaves  $1\frac{1}{2}$  to 2 ins. long by 1 to  $1\frac{1}{4}$  ins. broad.

The cymes are simple or compound in the axils of the upper leaves; the common peduncle is angular and elongate, 1- $1\frac{1}{2}$  ins. long; the pedicels are minute, articulate, and bibracteolate below the calyx; bractlets small, triangular. The calyx is

turbinate, minute, four-lobed, the minute lobes extending down to the disk, imbricate, and early deciduous. The petals are minute, obovate, often emarginate, pinkish, generally discreet, but sometimes united and falling off together. Stamens 20-30, shorter than the petals; style short; ovary two-loculed, with ten or more ovules in each locule.

The fruit is a bright red, turbinate or globose berry, flat at the top, about one-third inch in diameter. The flesh is resinous-astringent and insipid. The berries mature in the latter part of the summer, and are often very abundant. The fruit is eaten by the birds, but is scarcely suitable for human consumption. It was not used by the primitive Hawaiians. There are one or two seeds, with a pale, thin testa; the thick cotyledons are not consolidated.

The *Ohia ha* occurs in the lower rain forests of all the islands in the group, from one- to four-thousand feet elevation. It does not form pure stands, but occurs here and there throughout the forest, reaching its best development at the lower levels, in protected situations. On the exposed summit ridges and slopes it is dwarfed and shrubby. Representative localities where the *Ohia ha* is plentiful are: the Wainiha and Na Pali regions of Kauai'i; Ka-hana and Puna-luu on Oahu; the great valleys of East Molokai'i; the northern slopes of Hale-a-ka-la, and the Kohala forests of Hawai'i.

The second indigenous species, *Eugenia rariflora* Benth., is very rare in the Hawaiian Islands, but is common in the South Seas,—Samoa, Tahiti, and Fiji. It is a tall shrub with terete glabrous branches. The leaves are broad, ovato- to elliptico-oblong; they are quite variable in shape, and are often rhomboidal and acuminate, or obovate and obtuse, or even suborbicular. They are  $1\frac{1}{2}$ -3 ins. long by  $1-1\frac{3}{4}$  ins. wide, on extremely short petioles; glabrous, pale green, glossy above, chartaceous, with numerous minute oil-glands. The flowers are solitary in the axils, or sometimes two or more near the apex of short foliar axillary buds or spurs; on minute slender pedicels, which are minutely bibracteolate below the calyx. The calyx tube is puberulous, subglobose, minute, not produced, its four lobes

obovate or oblong. The stamens are numerous, as long as the petals, all free. Style short, slightly curved; ovary with two locules, each locule with eight amphitropous ovules. The berry is quite small,—about one third inch,—globose, dryish, and crowned with the calyx lobes. There are one or two globose seeds, ascending, with a thin, membranous testa, and filling the cavity; the thick cotyledons are not consolidated.

This species is confined to the lower portions of the rain forest, and is very rare. It has been collected on both mountain ranges of Oahu, and also from West Maui. Hillebrand states that “Our plant differs from that of the Southern islands in having thicker, more strongly veined, glabrous leaves, and a smaller fruit.” He also records a variety *parvifolia* with narrow elliptic, almost lanceolate leaves, about one inch long.

The most common of the introduced *Eugenias* is the so-called Java Plum, *E. jambolana* L. (*Syzygium jambolana* DC.). It is also known as Jambolan, or Jambolan Plum. It is abundant along many roadsides; in old fields and pastures; in the vicinity of native settlements; and here and there everywhere along the lowlands. The mynah-birds and doves, as well as the children, are very fond of the fruit, and have evidently played an important part in distributing the plant. It is native to the East Indies, but has become widely distributed in warm countries, and was brought to the Hawaiian Islands in early times. It grows as a tall shrub or tree, and often reaches a height of thirty or forty feet. The smooth, light-colored bark, and open crown, are distinctive features.

The leaves are 4–6 ins. long by 2–3 ins. broad, broadly oblong, shortly acuminate, and broad at the summit. The flowering season is from June into August, and during this time the trees are filled with fragrant white blossoms. The abundant nectar and pollen attracts the bees and other insects in great numbers. There is considerable variability in time of fruiting, so that the fruiting season is prolonged over a number of months, from late spring well into the fall. The main crop comes from September to November. The fruit is borne in dense clusters; the individual drupe is oblong,  $\frac{1}{2}$  to  $1\frac{1}{2}$  ins. long, purplish-black, with a thin,

easily crushed skin, and a quantity of very juicy, purple-black flesh. It contains one large, oblong seed. The unripe fruit is very astringent, so that thorough ripening is necessary to render the fruit edible. The richly colored juice stains the mouth of the eater, and one can easily recognize an urchin who has been feasting on Java Plums. The fruits scatter from the trees in such quantities at the height of the season, that the ground or sidewalk below is conspicuously stained; this has led to a dislike for it as a shade tree in the city.

A small-foliaged variety, with light green, narrow leaves, and small fruit, is said to have been introduced many years ago by Dr. Hillebrand, and is now common in gardens and estates. The astringent bark of the Java Plum is used in other countries in dyeing, tanning, and medicine; although the tree is abundant in Hawaii, the wood and bark are rarely utilized.

Another very common introduced *Eugenia* is the rose apple, *E. jambos* L. (*Jambosa vulgaris* DC.; *J. jambos* Millsp.). This species is also known as Jamrosade or Jambos. It is native to the West Indies, but was introduced into the Hawaiian Islands many years ago, and is now abundant in the valleys, around native settlements, along streams and old roadways. It is a large shrub or medium sized tree, reaching a height of twenty or thirty feet. The foliage is abundant and attractive, although the crown is often unkempt and scraggling. The leaves are lanceolate, very acuminate, thick and glossy; 5-8 ins. long and 1-2 ins. broad. From January to April, and sometimes later, the crown is filled with the large fluffy flowers; the pompons are creamy white, and contrast pleasingly with the dark foliage. The fruit is pyriform or globular, somewhat compressed, and 1-2 ins. in diameter. The skin is smooth, light creamy yellow in color, and often with a pink flush on one cheek. The flesh is firm, crisp, and tender, with a delightful flavor and odor. The aroma is like that of a delicate perfume. The cavity is relatively large, and contains a single round seed. The fruit requires several months to mature, and the season ends in August and September, depending upon locality. The fruit is much used in the tropics for jelly-making and in confection; the plant as a whole is prized for its rich foliage

and showy flowers. It is readily propagated by either cuttings or seeds. The latter geminate easily, and there is usually a large number of seedlings under any rose apple tree.

The French cherry or pitanga is a fairly common garden shrub in the Hawaiian Islands, particularly in the older gardens and estates. It is also called Surinam cherry, *E. uniflora* L. (*E. Michellii* Lam.). It is a native of tropical Brazil, but may now be found in many warm countries, where its fruit is much esteemed for jellies. It is a shrub varying in height from five to twenty feet; ten feet is an average size. Like the other *Eugenias*, the foliage is attractive; the leaves are glossy dark green, ovate-lanceolate, obtuse at the base, 1-2 ins. long, and exceeding the peduncles. The flowers are small, single, white, and quite fragrant. They are borne in profusion under favorable conditions. The fruit is  $\frac{1}{2}$ -1 inch in diameter, the size of a cherry, on short peduncles. It is amber colored, finally becoming rich crimson, and semi-translucent. The conspicuous feature of the fruit is the deep longitudinal ribbing or fluting; the convex surfaces are rounded, the depressions angular. The unripe fruit is decidedly astringent, but when fully mature it possesses a delicious spicy, acid, aromatic flavor. The fruit contains a single large, smooth, globular seed. In Hawaii the fruit is eaten out of hand, and also used for jelly-making. It occurs on all the islands; large bushes occur in Nu'u-anu, Wai-alaie, and at Moana-lua; also in the Hilo district of Hawai'i, and the Lihue region of Kauai'i.

The seventh member of this interesting genus that is prevalent in the islands is *E. brasiliensis* Lam. (*E. dombeyi* Skeels). This is called Brazilian plum or Spanish cherry; in Brazil, its native home, it is known as the Grumixameira. In habit it varies from a shrub to a large tree of fifty feet; in the Hawaiian Islands it is usually about twenty feet high. It requires considerable moisture for its best development, as do all the *Eugenias* in our flora; the largest crops are borne by plants at the lower levels, up to 300 feet. The leaves are obovate-oblong,  $2\frac{1}{2}$ -5 ins. long and 1-2 $\frac{1}{2}$  ins. broad, tapering at the base and blunt at the apex, dark green and glossy. The flowers are white, like those of *uniflora*;

flowering and fruiting continues from July until December, the main crop coming in the fall. The peduncles are 1-2 ins. long, and greatly exceed the scales which subtend them. The fruit is the size of a cherry, scarlet or deep purple, sometimes almost black at maturity. It is easily recognized by the conspicuous persistent calyx lobes. The flesh is sweet, juicy, and with an agreeable flavor. The fruits are eaten out of hand, and are also candied or preserved. The first plants in Hawai'i were probably introduced by the Spaniard, Don Francisco de Paula Marin, who came to the islands in 1791, and remained until his death in 1837. He introduced, cultivated, and distributed many useful plants. Fine trees of the Spanish Cherry occur in Pauoa, Ma-kiki, Nu'u-anu, and on old estates in various parts of the islands.

There are several other rare or undetermined exotic *Eugenias* in a few of the old Honolulu gardens, but the seven species that have been enumerated and described represent the bulk of the group in our flora. At one time in the early history of Hawaii's agriculture an endeavor was made to introduce the clove tree (*Eugenia aromatica* Baill), the flowers of which constitute the valuable cloves of commerce, but the enterprise was unsuccessful. Undoubtedly, as interest in Hawaiian horticulture grows and become more thoroughly organized, many of the other interesting members of this large group will find a place in the island flora.

COLLEGE OF HAWAII,  
HONOLULU, HAWAII

## HABENARIA REPENS AND PIAROPUS CRASSIPES IN LEON COUNTY, FLORIDA

BY ROLAND M. HARPER

Almost every outdoor botanist can recall several pairs of unrelated species that seem to be fond of each other's company, so to speak. In some cases one is evidently dependent on the other, *e. g.*, as parasite or epiphyte, but in most cases perhaps the only explanation is that they both prefer the same combination of environmental factors.\*

\* See A. A. Eaton, *Fern Bull.* 5: 29. 1897; Harper, *Torreya* 6: 192-193. 1906.